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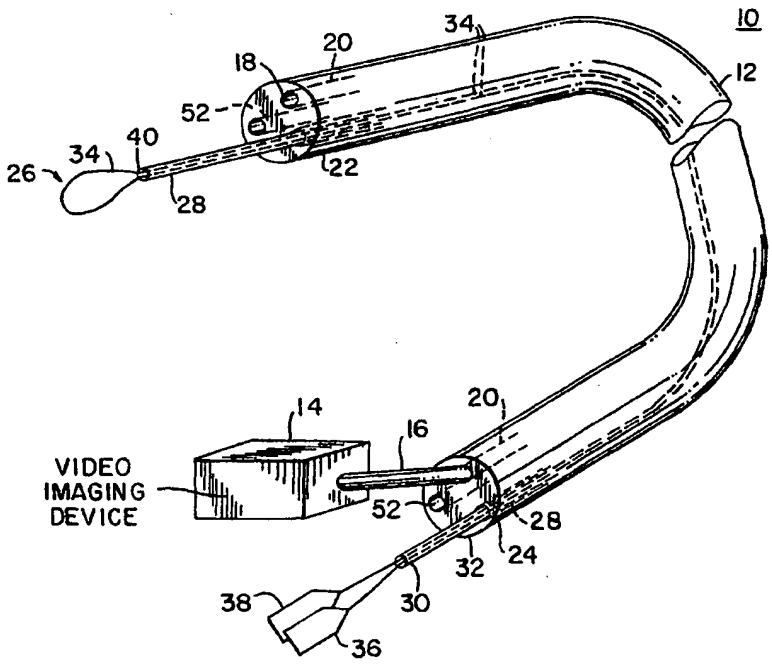
(54) Title: MEDICAL INSTRUMENT WITH EXTENDABLE SNARE

(57) Abstract

An elongated medical instrument with a snare is provided. The snare reciprocates within a sleeve in the instrument. The sleeve reciprocates within the instrument. The snare can be closed without moving the distal portion of the remainder of the instrument by advancing the sleeve while the snare is maintained in a fixed location. The snare can also be closed by retracting the snare into the sleeve or by advancing the sleeve while the snare is retracted. The snare may be formed from a continuous length of wire that is doubled back on itself within the sleeve. The size and lateral position of the snare can be adjusted by controlling the relative amount that the two portions of the doubled back wire are advanced beyond the end of the sleeve.



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MEDICAL INSTRUMENT WITH EXTENDABLE SNARE

Background of the Invention

This invention relates to medical instruments, and more particularly to elongated medical instruments with distal image receptors and snares.

Elongated medical instruments are widely used in modern medical procedures for surgery, drug delivery, imaging, and other functions. Certain procedures require the use of a snare located on the distal portion of the instrument (see, for example, Goldsteen et al. U.S. patent application No. 08/745,618, filed November 7, 1996, which is hereby incorporated by reference herein in its entirety). The snaring operation can be viewed using a fiber optic scope or other image receptor also located on the distal portion of the instrument. However, if the image receptor is fixed to the same structure to which the snare is fixed, it can be difficult to maneuver the snare without disturbing the field of view covered by the image receptor.

It is therefore an object of the present invention to provide an elongated medical instrument having a snare that can be operated without disturbing

the position of an adjacent image receptor on the instrument.

Summary of the Invention

This and other objects of the invention are accomplished in accordance with the principles of the present invention by providing an elongated instrument having a distal snare that can be advanced beyond the distal portion of the remainder of the instrument, for example, by extending a sleeve which houses the snare per se. The axial position of the snare can be adjusted independent of the axial position of the sleeve. If desired, the snare may be closed by distally advancing the sleeve while holding the snare, or by proximally retracting the snare while the sleeve is maintained in a fixed position. The snare may also be closed by distally advancing the sleeve while proximally retracting the snare. Because the snare and the sleeve are independently axially movable relative to the remainder of the instrument, any of these motions of the snare and sleeve can be accomplished without disturbing the remainder of the instrument. Because the distal portion of the remainder of the instrument can thus remain stationary during the snaring procedure, the field of view from an image receptor on the instrument is not disturbed.

The snare may be formed of a continuous elongated member (e.g., a wire) that is doubled back on itself to form first and second legs or wire portions, each of which extends between the proximal and distal portions of the instrument, and each of which is independently axially movable along the length of the instrument. The size and lateral position of the loop in the snare can be adjusted by controlling the amount

that the distal portion of each wire portion is distally advanced beyond the sleeve.

Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

Brief Description of the Drawings

FIG. 1 is a simplified perspective view of an illustrative instrument constructed in accordance with the invention.

FIGS. 2a and 2b are simplified perspective views showing how an illustrative instrument constructed in accordance with the present invention can be provided with steering capabilities.

FIGS. 3a and 3b are simplified diagrams showing how the size of an illustrative snare loop can be adjusted.

FIGS. 4a and 4b are simplified diagrams showing how either side of another illustrative snare loop can be selectively opened.

FIGS. 5a and 5b are simplified diagrams illustrating the capture of another structure such as a wire by the snare.

FIG. 6 is a simplified diagram showing a snare in which the axial position of the snare is controlled by a loop positioning member.

Detailed Description of the Preferred Embodiments

An illustrative elongated instrument 10 in accordance with the present invention is shown in FIG. 1. Body member 12 of instrument 10 is preferably an elongated body member suitable for longitudinal insertion into the body of a patient during a medical

procedure. For example, body member 12 may be a multilumen structure of polyurethane.

The site at which a given medical procedure is being performed may be viewed with a fiber optic scope which includes video imaging device 14, optical fiber 16, image receptor 18. If body member 12 is a multilumen structure, lumen 20 may be provided for optical fiber 16. (Although lumen 20 and the other lumens in FIG. 1 are only partly shown to avoid over-complicating the drawing, it will be understood that these lumens extend through the entire length of body member 12.)

When performing a medical procedure, the physician may position distal instrument portion 22 by manipulating the proximal portion 24 of body member 12, which is not inserted into the body of the patient. If desired, instrument 10 may be provided with the capability to steer tip 22 using conventional steering mechanisms or using the curved wire steering arrangement described in Bachinski et al. U.S. patent application No. 08/842,391, filed April 23, 1997, which is hereby incorporated by reference herein. An illustrative medical instrument 54 having such a curved wire steering arrangement is shown in FIG. 2a and 2b. The wire steering features of illustrative medical instrument 54 are shown separately from the snare features of the present invention to avoid over-complicating the drawings. However, the wire steering features and extendable snare features of the invention are preferably incorporated into the same medical instrument.

In the wire steering arrangement of FIG. 2a, member 56 has lumen 58 (partly shown) in which wire 60 reciprocates. Wire 60 is inserted into lumen 58

through proximal opening 62. Lumen 58 is preferably closed at distal end 64, but it may instead be open if desired.

Stiffening member 66, which may be, for example, a tubular stiffening cage formed of a stainless steel braid with a polyimide covering, is approximately two inches (5 cm) long and is preferably located a comparable axial distance from distal end 68 of member 56. These dimensions are only illustrative and any other suitable dimensions may be used.

With wire 60 inserted in member 56, the portion 70 of instrument 54 between medial stiffening member 66 and proximal end 72 of instrument 54 is preferably flexible enough to allow portion 70 to flex during insertion through narrow and twisted body organ structures such as blood vessels, but is stiff enough to allow instrument 54 to be advanced into various organ structures by the physician.

The distal portion 69 of member 56 between stiffening member 66 and distal end 68 is preferably stiff enough to assume the straight, undeflected alignment shown in FIG. 2a when wire 60 is withdrawn from within portion 69.

Distal portion 74 of wire 60 has a predefined curved shape when not confined by stiffening member 66. The position of wire 60 within member 56 may be controlled by the physician by manipulating wire positioning member 76. When distal wire portion 74 is pushed beyond edge 78 of stiffening member 66, distal wire portion 74 begins to assume its natural curved shape and deflects distal member portion 69, as shown in FIG. 2b.

The angular orientation of distal member portion 69 can be controlled by rotating wire

positioning member 76 and thereby rotating the curved distal wire portion 74. In addition, the extent of the lateral or angular deflection of distal member portion 69 can be adjusted by controlling the length of distal wire portion 74 that extends beyond edge 78. The lateral or angular deflection of distal member portion 69 is greatest when all of distal wire portion 74 extends beyond edge 78. When distal wire portion 74 is fully retracted, distal wire portion 74 is confined by stiffening member 66 and there is no lateral deflection of distal member portion 69. When a fraction of distal wire portion 74 extends beyond edge 78, the lateral deflection of distal member portion 69 is less than the lateral deflection when distal wire portion 74 is fully extended but greater than the lateral deflection when distal wire portion 74 is fully retracted. A lumen such as lumen 80 or 82 may be used to house snare 26 (FIG. 1)

Regardless of the technique used to position distal instrument portion 22, once distal instrument portion 22 is positioned in the proper location for viewing the site of the procedure, snare 26 can be extended out from distal portion 22 by distally advancing sleeve 28, as shown in FIG. 1. The physician can control the position of sleeve 28 by manipulating proximal portion 30 of sleeve 28 where it protrudes from proximal end 32 of body member 12. Snare 26 is independently controlled. Sleeve 28 is preferably formed from plastic (e.g., polyimide) tubing.

With the snare arrangement shown in FIG. 1, snare 26 is formed from a continuous single wire 34 that is doubled back on itself within body member 12 and sleeve 28. One proximal end of wire 34 is controlled by wire positioning member 36 and the other

proximal end of wire 34 is controlled by wire positioning member 38. Wire positioning members 36 and 38 can be directly manipulated by the physician or can be manipulated by a suitable mechanism controlled by the physician.

If it is desired to rotate snare 26, wire positioning members 36 and 38 can be rotated together, thereby rotating wire 34 within body member 12 and sleeve 28. Wire 34 is preferably formed from nitinol or stainless steel and has sufficient torsional stiffness to translate torque from wire positioning members 36 and 38 to snare 26 when snare 26 is to be rotated.

A distal portion of snare 26 may be resiliently biased to open out in the form of a loop as shown in FIG. 1. This loop is preferably closed by maintaining the loop of snare 26 at a fixed location while sleeve 28 is advanced distally. Distal end 40 of sleeve 28 forces snare 26 to close. Closing snare 26 by advancing sleeve 28 prevents snare 26 from moving away from the object that is being snared while snare 26 is closing. In addition, because snare 26 does not move during the snaring operation, the position of the distal portion 22 of body 12 is not disturbed, thereby allowing the image seen by image receptor 18 and displayed by video imaging device 14 remain steady and undisturbed.

If desired, snare 26 can be closed by proximally withdrawing wire 34 relative to body member 12 while sleeve 28 is maintained in a fixed position. This retracts snare 26 into distal end 40 of sleeve 28 and forces snare 26 to close. Another way in which to close snare 26 is to proximally withdraw wire 34 while simultaneously distally advancing sleeve 28.

Forming snare 26 from a continuous length of wire 34 is one way to allow the size of the loop in snare 26 to be adjusted. As shown in FIG. 3a, advancing wire 34 slightly beyond distal end 40 of sleeve 28 creates a relatively small loop. As shown in FIG. 3b, advancing wire 34 farther beyond distal end 40 creates a relatively large loop.

Another illustrative embodiment of snare wire 34 is shown in FIGS. 4a and 4b. In this embodiment the two legs 34a and 34b of wire 34 are joined at their distal ends in a fairly sharp crease 42. The distal portion of wire 34 is not resiliently biased to open into a loop. Instead, an open loop is formed by shifting either one of legs 34a or 34b distally relative to the other leg. For example, FIG. 4a shows the result of shifting upper leg 34a distally relative to lower leg 34b, while FIG. 4b shows the result of shifting lower leg 34b distally relative to upper leg 34a. Whichever leg is shifted distally bulges out away from the other leg to produce an open loop which may have the shape of a duck head. The size of this loop depends on the amount of relative shift between legs 34a and 35b, and the lateral direction of the loop depends on which leg 34a or 34b is shifted distally relative to the other leg.

A typical snaring operation is illustrated in FIGS. 5a and 5b. In FIG. 5a, snare 26 is extended and the physician has manipulated snare 26 so that it surrounds another structure (e.g., wire 44). Wire 44 may be, for example, a guidewire that is being maneuvered through the patient's body. In FIG. 5b, the physician has retracted snare 26 into sleeve 28 by retracting wire 34 and/or by extending sleeve 28. FIG. 5b shows how the relatively narrow inner diameter

of sleeve 28 causes wire 44 to fold over on itself, so that wire 44 is held firmly in sleeve 28 and securely interengages with wire 34.

Snare 26 is preferably formed from a single continuous wire 34 that doubles back on itself within body member 12 to form independently controllable wire portions 34a and 34b (as shown, e.g., in FIGS. 4a and 4b). If desired, however, snare 26 may be formed (as shown in FIG. 6) from a separate wire loop 46 that is attached to loop positioning member 48 at connection 50. Loop positioning member 48 may be formed from wire or hypotube.

If desired, instrument 10 may be provided with additional capabilities. For example, instrument 10 can be provided with illuminating, surgical, or drug delivery capabilities. One or more lumens such as lumen 52 (FIG. 1) may be provided in body member 12 to support these functions. Lumen 52 may contain fiber optics for illumination or laser ablation, may form a passage for irrigation and/or drainage, a cutting or biopsy tool, or an anchoring wire.

It will be understood that the foregoing is only illustrative of the principles of the invention, and that various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention.

The Invention Claimed Is

1. A medical instrument comprising:
an elongated body member;
a sleeve that reciprocates within said elongated body member; and
a snare that reciprocates within said sleeve.

2. The instrument defined in claim 1 wherein said snare is formed from a single continuous wire that is doubled back on itself within said elongated body member to form a first wire portion and a second wire portion.

3. The instrument defined in claim 2 wherein the lateral position of said snare is adjusted by controlling the relative amount that said first and second wire portions are advanced beyond said sleeve.

4. The instrument defined in claim 2 wherein the size of said snare is controlled by adjusting the amount that said first and second wire portions are advanced together beyond said sleeve.

5. The instrument defined in claim 2 wherein said snare has a crease.

6. The instrument defined in claim 1 wherein said snare has a snare loop connected to a loop positioning member.

7. The instrument defined in claim 1 wherein said snare is closed by advancing said sleeve

over said snare while said snare is maintained in a fixed position.

8. The instrument defined in claim 1 wherein said snare is closed by retracting said snare into said sleeve while said sleeve is maintained in a fixed position.

9. The instrument defined in claim 1 wherein said snare is closed by simultaneously advancing said sleeve and retracting said snare.

10. The instrument defined in claim 1 wherein said elongated body member contains fiber optics for imaging.

11. The instrument defined in claim 1 wherein said sleeve has a proximal end that extends out of a proximal end of the elongated body member.

12. The instrument defined in claim 1 wherein said snare is formed from at least one wire contained within said sleeve that extends out of a proximal end of said sleeve.

13. The instrument defined in claim 1 further comprising a curved wire that reciprocates within the elongated member for steering a proximal end of the elongated body member.

14. A method for using a medical instrument having an elongated body member, a sleeve within the elongated body member, and a snare within the sleeve, comprising the steps of:

reciprocating said sleeve within said elongated body member; and

reciprocating said snare within said sleeve.

15. The method defined in claim 14 further comprising the step of forming said snare from a single continuous wire that is doubled back on itself within said elongated body member to form a first wire portion and a second wire portion.

16. The method defined in claim 15 further comprising the step of adjusting the lateral position of said snare by controlling the relative amount that said first and second wire portions are advanced beyond said sleeve.

17. The method defined in claim 15 further comprising the step of controlling the size of said snare by adjusting the amount that said first and second wire portions are advanced together beyond said sleeve.

18. The method defined in claim 15 further comprising the step of providing a crease in said snare.

19. The method defined in claim 14 wherein said snare has a snare loop connected to a loop positioning member.

20. The method defined in claim 14 further comprising the step of closing said snare by advancing

said sleeve over said snare while said snare is maintained in a fixed position.

21. The method defined in claim 14 further comprising the step of closing said snare by retracting said snare into said sleeve while said sleeve is maintained in a fixed position.

22. The method defined in claim 14 further comprising the step of closing said snare by simultaneously advancing said sleeve and retracting said snare.

23. The method defined in claim 14 further comprising the step of providing fiber optics in said elongated body member.

24. The method defined in claim 14 wherein said sleeve has a proximal end that extends out of a proximal end of said elongated body member.

25. The method defined in claim 14 further comprising the step of forming said snare from at least one wire contained within said sleeve that extends out of a proximal end of said sleeve.

26. The method defined in claim 14 further comprising the step of steering a proximal end of the elongated body member with a wire member that reciprocates within the elongated body member.

27. A medical instrument comprising:

an elongated structure having axially spaced proximal an distal portions;

an image receptor disposed on the distal portion and configured to receive an image and to transmit it to the proximal portion; and

a snare structure disposed on the distal portion and configured to selectively engage a structure to be snared by relative axial movement of first and second snare substructures, each of said snare substructures extending to the proximal portion and each being substantially independently axially movable along the elongated structure.

28. The instrument defined in claim 27 wherein a distal portion of the first snare substructure is resiliently biased to open out into a loop.

29. The instrument defined in claim 28 wherein the second snare substructure includes a sleeve configured to selectively receive and substantially close the loop.

30. The instrument defined in claim 27 wherein the first snare substructure includes an elongated member which extends from the proximal portion to the distal portion and back to the proximal portion.

31. The instrument defined in claim 30 wherein the second snare substructure includes a sleeve configured to selectively receive a distal portion of the elongated member.

32. The instrument defined in claim 30 wherein each leg of the elongated member between the